The feasibility of motion-sensing technology for assessment of functional performance of elderly

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Objectives

This study aims to investigate 1)correlation between the kinect-based system and conventional examination of physical fitness and 2)general satisfaction

Methods

A total of 126 subjects were included in this study(age: 69.2± 6.5 years, BMI: 23.3± 3.2 kg/m2). The inclusion criteria was as follows: 1) between 55-85 years old, 2) able to walk independently more than 10 meters, 3) normal upper extremity function. While, people with critical medical issues that may affect the motor performance like severe cardiopulmonary disease and hearing or visual impairments were excluded. The participants were asked to complete a series of test procedures which contain 6 different physical fitness tasks measured by both kinect-based system and conventional physical examination methods.

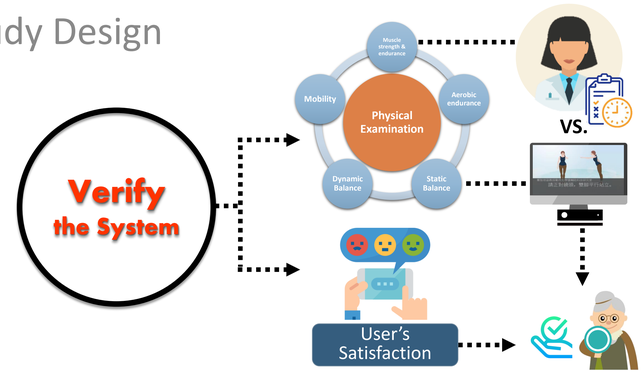
Physical fitness outcomes of arm curl, chair stand, functional reach, one leg stance, 8-feet up and go and 2-min step were examined. The correlation of these measurements between motion-sensing technology and physical examination was obtained. The satisfaction of overall experience for kinect based system was indicated by system usability scales(SUS). Shapiro-Wilk test was performed to assess normal distribution for all parameters. Use of Pearson's correlation coefficient(r) analyzed the correlation of physical fitness outcomes between motion-sensing technology and manual evaluation. The significant level was set at p <0.05.

Instrumental setting

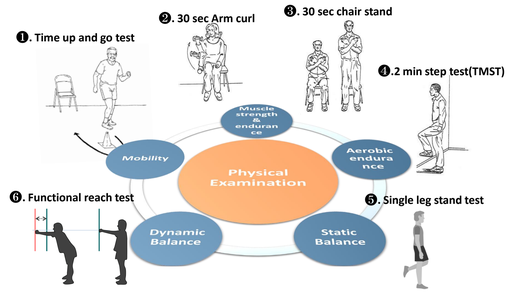
Kinect V2 for Xbox 360™, Microsoft Corp, Seattle, WA, USA
Depth sensor Kinect V2 for Xbox 360™, Microsoft Corp, Seattle, WA, USA

- Depth sensor
- Customized software and algorithm

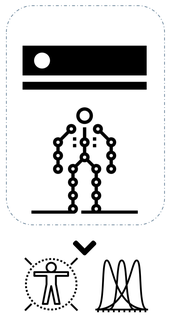
Study Design



6 Physical Examinations



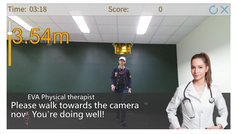
Manual approaches



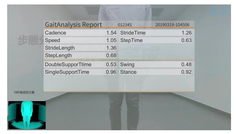
Auto-analysis with Kinect

Key capabilities of software

Tutorial



Measure



Directly show results

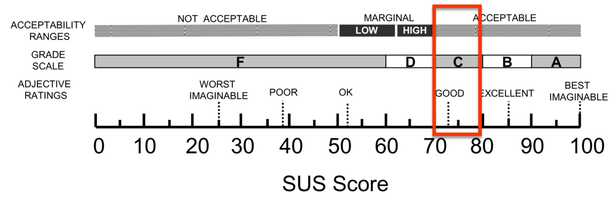
Results of Correlations

Examination	MS	PE	*r*	*P*
OLS (s) N=125	26.1(14.8)	24.7(14.9)	0.948	<0.01*
FR (cm) N=126	32.7(5.9)	32.4(5.2)	0.517	<0.01*
30sCST (times) N=126	15.8(4.4)	15.8(4.4)	0.998	<0.01*
8FUG (s) N=126	8.0(2.5)	6.7(1.8)	0.937	<0.01*
30sAC (times) N=126	16.8(3.9)	16(4.0)	0.991	<0.01*
TMST (steps) N=125	210.7(43.4)	210.8(43.4)	0.985	<0.01*

Mean(SD)：*r*, Pearson's correlation coefficient：*significant difference, *P*<0.05：
MS, motion-sensing system/PE, physical evaluation; OLS: one leg stance/FR: functional reach/ 30sCST: 30 seconds chair stand test/ 8FUG: 8-feet up and go/ 30sAC: 30 seconds arm curl/ TMST: two minutes step test

Satisfaction Results-SUS

Scoring: [(N1-1)+(N3-1)+(N5-1)+(N7-1)+(N9-1) + (5-N2)+(5-N4)+(5-N6)+(5-N8)+(5-N10)] X 2.5 = **72.25±17.58**



Results

Significantly high correlation(r>0.9, p<0.001) was found across the majority of variables except for the functional reach test, only showing moderate correlation level(r= 0.517, p<0.01) that may attribute to the algorithm bias. As for the SUS, overall satisfaction of the system via all the valid questionnaire from subjects was good.

Conclusions

It is suggested that kinect based system is not only feasible for the entertainment or exercise related applications, but also have great potential to assess the functional outcomes of elderly. Future work are needed to enhance the adaptive algorithm as well as to verify the application of such automated screening system to widely detect the functional defects in people with frailty or movement disorders.

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